

SCIENCE IN GERMANY

(From a German Correspondent)

IT is known to have been first discovered theoretically by Maxwell, that the co-efficient of friction of a gas is independent of the pressure. This law has been tested and confirmed by Maxwell and O. E. Meyer, and more recently by Kundt and Warburg (*Philosophical Magazine*, 4, vol. iv.; and fully in *Poggendorff's Annalen*, Bd. 155 and 156) with reference to the sliding of gases in limits between 760 and 1 mm. pressure of mercury. The latter experimenters observed, as Maxwell did, the decrease of vibrations of a round glass disc suspended bifilarly between two fixed plates. At pressures under 1 mm. Kundt and Warburg were unable accurately to investigate the friction. They could perceive, however, that with continued progressive evacuation by the friction apparatus, the damping

force exerted by the rarefied gas on the motion of the oscillating disc, decreases; still, even in the best vacuum which could be produced, it had still a considerable value. Thus, *e.g.*, in the best hydrogen vacuum which Kundt and Warburg could produce, the damping force was not less than one-third of the value obtained with full hydrogen-pressure (760 mm. mercury).

To demonstrate the friction in such a vacuum before a large audience, Prof. Kundt recently constructed an apparatus, which he employed when giving a lecture on the gas theory before a scientific society in Berlin in March last. The essential part of the apparatus consists of two small discs of mica, suspended one over the other in an evacuated space. When the under disc, which, like Crookes's radiometer, is furnished with four light vanes blackened on one side, is set in rotation by the action of light, the upper disc begins to rotate in the same direction (though much more slowly) in consequence of the friction of some traces of air still present in the apparatus. (The upper disc of course nowhere touches the lower.) The description of this apparatus with drawings, will shortly appear in *Poggendorff's Annalen*. Here we content ourselves with the representation of a smaller

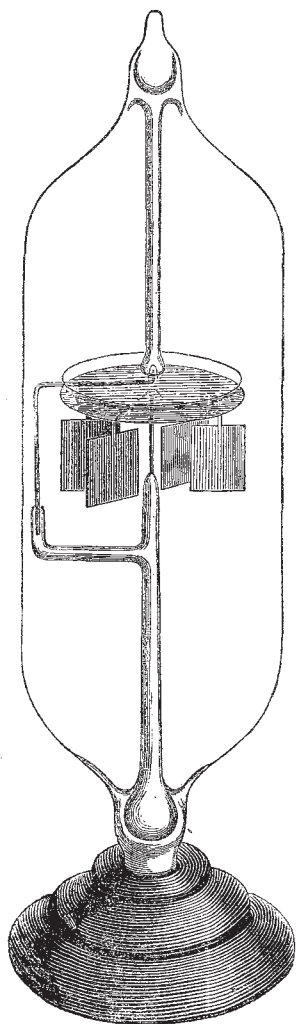
apparatus not meant for objective demonstration (see annexed figure) which the eminent glass-artist, Geissler, of Bonn, has constructed at the instance of Prof. Kundt. This apparatus, like the ordinary radiometer, is entirely inclosed in glass. On a fine steel point rests, by means of a cap, the lower mica disc, with the radiometer cross fixed to it. The upper disc rests likewise on a fine steel point. This point is fixed to an arm which reaches over the lower disc, but without being in contact with it. On the upper disc a small mark

is made (not shown in the figure), which enables one to perceive whether the disc rotates or not. Illuminated by the sun or candles, the radiometer cross with the mica disc fastened to it, enters into quick rotation, and the upper disc begins gradually to rotate in the same direction as the lower one. S. W.

ON MODES OF DEMONSTRATING THE ACTION OF THE MEMBRANA TYMPANI

THE movements of the bones of the tympanum in connection with sound-waves were first observed and their excursions measured by Buck (*Archiv. of Ophthalmology and Otology*, vol. i., 1870), and more recently by Dr. Charles H. Burnett of Philadelphia, as recorded in the same Journal for 1872. The method followed in these researches was to expose the bones and membrane by chiselling away a portion of the wall of the tympanum, sprinkling on the chain of ossicles a little powdered amylum, so as to secure bright vibrating points, throwing light into the cavity by means of a condenser, and observing, with a microscope of low power, the excursions of the vibrating points when sound was conducted into the external ear. Various interesting deductions were drawn from these experiments as regards the amplitude of the excursions of vibrating points on different portions of the conducting mechanism, and as to the effect of variations of the fluid pressure within the labyrinth on the extent of movement. In the last number of the same journal an interesting paper appears from Dr. Clarence J. Blake of Boston on "the use of the Membrana Tympani as a Phonautograph and Logograph," accompanied by a plate. Dr. Blake's method consists of exposing the membrane and chain of bones, and fixing a light style (made "by splitting long wheat straw, scraping the inner cortical substance away, and separating single fibres") to the membrane. This style is caused to record its movements on a plate of smoked glass which is "carried smoothly and at a uniform speed in a direction at a right angle to the direction of the excursion of the style." . . . "The membrana tympani being set in vibration, and the carriage [bearing the smoked glass] drawn by its weight, moving at right angles to the excursions of the style, a wave-line, corresponding to the character and pitch of the musical tone sounded into the ear, is traced on the smoked glass."

There is still a third method which I have recently devised, chiefly for class illustration. It consists in converting the tympanic cavity into a manometric capsule, according to the method of Dr. Koenig (*Philosophical Magazine*, 1873, vol. xlv. pp. 1-18, 105-114), and of viewing the oscillations caused by sound in a revolving mirror. A preparation is easily made from the ear of the cat. After sawing out the temporal bone, clearing away all loose tissue, and exposing the tympanic bulla, I make two small holes in the latter by means of a fine trephine. Into these holes two glass tubes, of corresponding diameter, are cemented with sealing wax—the one for leading gas into the tympanic cavity, and the other out of it. The preparation (which may be preserved in a moist state in a well-stoppered jar for a long period, and be used over and over again) is firmly fixed in a vice, one tube is connected with the gas supply, and the other with one of Koenig's small burners. By means of a third tube inserted into the external auditory meatus, sound-waves are conducted to the membrane of the drum, the mirror is rotated, and the usual pictures corresponding to the pitch and quality of the sound are seen with exquisite delicacy. I have found tones of medium pitch (ut 3 to sol 4) produce the most distinct effects, and the vowels, if uttered with sufficient intensity, produce pictures which are quite characteristic. By using a preparation in which the auditory apparatus on each side is present, it is easy to devise an arrangement for showing the effects of



interference, in a manner similar to Koenig's well-known apparatus for that purpose, constructed on the method of Wheatstone.

JOHN G. MCKENDRICK

THE GEOLOGICAL SURVEY OF NEW-FOUNDLAND

DUE notice of the Report for 1874, of Mr. Murray, the Director of the Newfoundland Geological Survey, has been delayed until the appearance of the map and sections referred to in that Report. These we have now received, and as they deserve more than ordinary attention from geologists, we propose to give some account of the recent work of the Survey. The able and indefatigable Director, who, like his late chief, Sir William Logan, has grown grey in the service of the Dominion, divides his Report into two parts, one of which narrates his own labours during 1874, while the other is furnished by his assistant, Mr. J. P. Howley, of whose surveys for the same period it gives the main results. Mr. Murray's Report is marked by that quiet practical good sense which formed so characteristic a feature of his contributions to the Canadian Geological Survey. It is more occupied with plans and advice for opening up the country to settlers, and developing the great resources of the island in timber and as a cattle-grazing district, than with geological matters. The latter are treated, too, with an eye to future mineral industries. Mr. Murray, in short, is doing the solid and useful work of pioneering. That work may make no brilliant display at the time, but if, as he hopefully anticipates, there is a prosperous future before Newfoundland, the colonists will look back upon his labours as those which largely guided and stimulated that prosperity.

But Mr. Murray is too true a geologist to let any chance escape him of advancing the purely scientific treatment of geology. And he is fortunate in possessing in Mr. Howley a geologist who can carry out his views with admirable skill. From Mr. Howley's Report and Map geologists in other countries will learn some particulars not only important as regards the geology of the colony, but of general interest as bearing on the question of the nature and *modus operandi* of the metamorphic action to which the origin of such rocks as dolomite and serpentine is attributed.

Mr. Howley's labours during 1874 were, in accordance with Mr. Murray's plans, given to the survey, topographical and geological, of the western coast of Newfoundland, about the peninsula and bays of Port-a-Port, and St. George's Bay. In tracing the Lower Silurian formations of the Newfoundland coast, Mr. Murray and his colleagues have been able to identify them with more or less precision as equivalents of the Quebec and Birdseye and Black River groups of Canada. But in the course of their surveys they have at different times encountered intercalated sheets of metamorphic rocks in the Lower Silurian series overlying unaltered and fossiliferous strata. Thus at Bonne Bay, in 1862, Mr. Richardson found highly metamorphosed rocks, including white talcose slates and serpentine, in some portion apparently of the Quebec group. Four years afterwards Mr. Murray observed further south, in the Bay of Islands, that sandstones believed to represent the Sillery zone of the Quebec group passed below the serpentine of the Blowmedown mountains. Mr. Howley has now confirmed and extended these observations by mapping the country between the Bay of Islands and St. George's Bay. He has traced Mr. Murray's serpentine rocks southwards to Bluff Head, and finds that they pass unconformably over different horizons of rocks which are taken to represent the Sillery and Levis subdivisions of the Quebec group of the Lower Silurian system. The striking character of this unconformable junction is well brought out upon the

map, where two large cakes of the overlying rocks are seen to sweep over both anticlinal and synclinal folds of the lower formations. These cakes consist of brecciated dolomite or limestone, chlorite-slate, diorite, and serpentine, having a total thickness of perhaps 1,500 feet. Their exact geological horizon seems not yet quite satisfactorily fixed, but they are placed provisionally between the Sillery and Birdseye and Black River formations. Doubtless further details will be given in future reports regarding this remarkable feature of Newfoundland geology, and till they appear it may be well to avoid any discussion of the theoretical aspect of the subject. It is not the first time that an instance has occurred of the higher rocks of a district being more metamorphosed than the lower, but there has probably never been observed so remarkable a case, for here the metamorphosed and contorted series is described as actually overlying unmetamorphosed strata.

Other questions of interest occur in the Report. Thus a centre of pre-carboniferous volcanic action is indicated as existing along a line north of Fox Island and on the coast to the south head of the Bay of Islands. The coal-measures, of which a few patches occur in the district surveyed, overlap from the Millstone Grit on to the Carboniferous Limestone. The latter formation contains, according to Mr. Davidson, brachiopoda which all belong to well-known British species. In another respect there is a curious analogy between the base of the Carboniferous system in Newfoundland and in some parts of Britain. In the former country the lower members of that system consist largely of red and green sandstones, clays, and conglomerates, with traces of plants, beds of gypsum, and occasional limestones full of ordinary Carboniferous Limestone fossils. Anyone who has looked at the base of the Carboniferous system in Cumberland, Westmoreland, Dumfriesshire, and other parts of Britain, will recognise these lithological features as characteristic also in this country. It would seem that the same physical conditions preceded the deposition of the Carboniferous Limestone on both sides of the Atlantic—inland seas or lakes, not far separated from the sea, in which red sediment with gypsum and occasionally common salt was laid down, but which were not usually well suited for the support of molluscan life, though liable now and then to inroads of the sea outside and to invasions of mollusca, corals, and other marine forms.

The map, on a scale of four miles to an inch, is evidently a piece of most careful work. It shows the arrangement of the rocks from the Laurentian group up to the Coal-measures, though, partly from vast unconformabilities and partly from faults, great portions of the geological series are not represented in this part of Newfoundland. It may be mentioned, in passing, that the largest fault traced on the map—that which flanks the Laurentian range from Table Mountain north-eastwards to Grand Pond—is not coincident with the line of any river, but is crossed by all the chief rivers and brooks in the district which it traverses. Hence the same relation between fracture and erosion exists there which has been so extensively traced and keenly discussed in this country. To the completion of this important map geologists will look forward with not less interest than must be taken by those who see in the labours of Mr. Murray and his associates one of the best pledges for the early development of the colony.

A. G.

THE ANCIENT BRITISH PIG

PROF. ROLLESTON has recently been making some researches on swine, the discovery of some remains buried in the alluvium, near Oxford, having directed his attention to the subject. In illustration of a paper "On the Prehistoric British *Sus*," read by him at the Linnean Society, June 15, the following specimens were exhibited:—1. Skull of *Sus scrofa*, var. *domesticus*, from a late Celtic interment. 2. Skulls of *Sus scrofa*, var. *ferus*, from